

FUTURE TRENDS POTENTIALLY IMPACTING AIR QUALITY IN THE PACIFIC NORTHWEST

I. Demographics:

- **All states and BC in the region will experience population growth although not as dramatic rates of increase as in last 20 years.**

	Current Population	Projected - 2010	Projected - 2020
Alaska	621,400 (1998)	683,600 (2008)	776,500 (2018)
Idaho	1,347,000 (2000)	1,622,000 (2015)	1,739,000 (2025)
Oregon	3,351,000 (2000)	3,857,000 (2010)	
Washington	5,900,000 (2000)	6,660,000 (2010)	7,560,000 (2020)
British Columbia			

- **Most important National and Regional trend is the aging population: baby boomers reaching retirement age.**
 - In Alaska, people age 65+ will increase from 1% of population to 12% by 2018, increasing in numbers by 182% since 1998. Population age 5-15 will shrink from 23% in 1998 to 21% in 2018.
 - In Washington, people age 65+ will increase from 11.3% of population in 2000, to 16.1% in 2025.
 - Some counties in Oregon have had more than 20% of age 65+ population migrate in within last 10 years
 - British Columbia will see age 65+ increase from 13% of population in 2000 to 16.5% in 2025.
- **Impacts of aging population:**
 - Shrinking labor force - may need to encourage more migration to fill jobs,
 - labor force will become more diverse in ethnicity, age and sex;
 - need for more flexible work schedules and locations to attract more workers
 - Older populations tend to live alone, need for more housing and alternative housing choices
 - older people tend to drive more and require more health care services and other personal services
 - increasing proportion of women to men in older age categories

II. Economy

- Continued trend of increase in personal income expected over next 20 years
 - Washington: per capita income will increase by 2/3 by year 2025 from 2000 level, remaining at 2.7% above national average. Total Personal Income will increase 125% between 2000 and 20205, increasing from \$173.8 billion to \$395.7 billion.
 - Alaska’s Permanent Dividend Fund payments have increased income levels of poorest families faster than wealthiest,
 - will replace oil revenues as largest source of income in next 25 years;
 - Alaska incomes fell to U.S. average in 2000 due to lower job growth and fewer high-paying jobs in oil and construction industries
- **Two most important National and Regional trends:**
 - transformation of economy from manufacturing to service economy
 - shift from era of “labor abundance” to “labor scarcity” due to aging population, slower growth in labor force and increasing skill intensity of employment
- **Main source of new jobs:**
 - **Alaska:** tourism, recreation, health care services. Oil and other resource industries are flattening or declining
 - **Idaho:** service sectors such as call centers; high-tech manufacturing and other good producing sectors. Farm-related and resource extraction jobs are declining
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 - Currently most trade-dependent state in the country, accounting for one in out of every three jobs in the state.
 - High-tech manufacturing will remain strong, through continued investments in productivity enhancement
 - Service sector will grow from 29% of jobs in 2000 to more than 33% in 2025.
 - Some growth in natural resource products, but will see more competition from Canada and overseas.
 - *Bar chart of shift in Washington Employment by Industry 1970 -2025.*
 - **British Columbia:**
 - Greater Vancouver will continue to dominate the provide for job growth, producing 55% of GDP.
 - Most of job growth will be in service sector and small businesses
 - Immigration will provide most of growth in labor force

III. Transportation

- **Overall national and regional trends:**
 - growth in desire/need for personal mobility
 - dramatic increase in domestic and international trade and travel
 - transformation from a manufacturing economy to a service economy with greater role for transportation
- **Business trends impacting movement of freight:**
 - increasing importance of e-commerce
 - mass customization of transactions at wholesale, retail level
 - **greater expectations for flexible service, rapid and reliable delivery**
 - increasing participation in global markets
 - **increasing freight traffic and congestion at ports and border crossings**
 - “just-in-time” and “lean” manufacturing
 - greater output from efficiency and productivity improvements,
 - smaller inventories, less slack production capacity
 - traffic growth is greatest for small shipments: smaller volume but higher value
 - **greater dependence on transportation services**
 - cross-modal coordination of transportation systems
 - **Need for closer integration of transportation system operations**
- **Trends in Trucks:**
 - More miles traveled per truck: 24% increase 1982 - 1992
 - Heavier loads: for 1982 - 1992 period
 - numbers in weight class over 800,000 pounds increased 180%
 - vehicle miles traveled in this weight class increased 193%
 - Role of parcel, postal and courier services now compose largest segment, as key element in inter-modal freight transportation
- **Growth Forecasts for Freight: 1998 - 2020**
 - U.S. Domestic: 2.9% per year, 87% cumulative
 - U.S. International: 3.4% per year, 107% cumulative
 - International sectors: US/Canada, 3.1% per year, US/ Mexico, 3.5% per year, US with rest of world, 3.4% per year.

Bar charts of Rail and Truck Traffic increase 2000 - 2020

Series of Maps showing increasing congestion from truck traffic growth on U.S. highways, 1998 - 2020

Table of current delays at U.S. border crossings
- **Ports/Ships Will See Dramatic Growth in Traffic:**
 - Strong competition between Vancouver (BC), Seattle, Tacoma and Portland
 - Vancouver drawing more traffic due to better rail and truck connections, faster shipping times to Asia and rail delivers to Chicago (one day faster than Seattle)
 - Tacoma setting records in container handling, becoming largest in Northwest, but Seattle has more international trade pass through its port.

- Portland is second largest exporter port for wheat in U.S. and largest bulk mineral port on West Coast.
 - International trade will play greater role in all West Coast ports, with Japan as largest trading partner
 - Ability to distribute goods in and out of Ports will be source of future competitive advantage
- **Passenger and Cargo Air Travel Expected to Grow Significantly**
 - All international airports in Pacific Northwest seeing greater volume of passengers and cargo
 - Portland International Airport (PDX) expects to double passengers from 13.7 million in 2000 to 27 million in 2020, due to employment growth, higher incomes, more international flights and lower cost domestic flights
 - PDX also expects cargo tonnage to increase from 344,000 to 485,000 tons by 2020 due to greater population, and trends in e-commerce and delivery requirements from “just-in-time” manufacturing.
 - PDX is considering options to handle increased traffic, including adding a third runway and new terminal
 - Task force recommends greater regional view of transportation systems to avoid high costs, over-building
 - *Graphs showing PDX’s projections in passengers and cargo tonnage*
 - Sea-Tac also projecting annual passenger and cargo growth rates of 2.5% per year for each.
 - By 2020, 77% increase in passengers from 2000 levels, reaching 44.6 million
 - Other general aviation airports in the state expect 20% increase in registered aircraft to 14,100 by 2020.
 - *Bar chart on WA’s projected air travel 1998-2020*
- **Passenger and Rail Traffic Expected to Grow with Targeted State Support**
 - Washington currently owns eight daily runs of Amtrak’s Cascade passenger rail system; Oregon owns four other trains.
 - Ridership has more than doubled every five years since 1993.
 - These runs currently diverted an estimated 143,000 vehicle trips from I-5 corridor in year 2000.
 - Ridership between Vancouver, BC and Portland estimated at 1,094,000 in 2002 and could grow to 1,920,000 in 2018
 - Investments in track improvements, congestion points could increase trains to 13 round-trips per day, reduce travel times by nearly an hour.
 - “Fruit Express:” state’s successful pilot to improve rail shipment of apples, other fruit products from eastern part of state, using existing Amtrak runs
 - Shows potential for removing tens of thousands of truckloads from congested highways
 - Provides another source of income for Amtrak, and offers reliable and safe commodity hauling for growers
 - Freight rail has smallest share of total freight moved but has best opportunity to grow

- Since 1970, 40% of Washington's active rail lines were abandoned
 - Freight traffic moved to trucks on state, local roads, causing higher road maintenance costs
 - Without state and federal investments to improve rail infrastructure, potential benefits of growth in passenger and freight rail will be lost
- **Factors for Current Auto Use in U.S. Will Continue in Future**
 - Passenger travel doubled between 1970 and 1995, growing average of 2.7% per year
 - Passenger-miles per person increased from 11,400 - 17,200 in this time
 - Factors influencing growth in passenger miles:
 - increase in work force, with more women working outside the home
 - greater employment rate, since employed people found to drive nearly twice as far as unemployed people.
 - More households and decrease in household size, resulting in more cars owned, more trips per household
 - Higher personal income, correlated with more auto ownership, long distance travel
 - More trips by parents taking children to school and after-school activities
 - Longer distance driven for work and errands per person with increasing sprawl
 - No rate of increase in use of transit, partly due to lack of suburb-to-suburb service
- **Most of Congestion on Roads Attributed to Increasing Sprawl, Will Worsen**
 - Between 1998 and 2020, in Washington State alone,
 - number of highways considered congested will increase from 11% to 32%
 - Interstates' congestion will increase from 27% to 64%
 - Congestion on principal arterials will increase from 13% to 41%
 - *Bar chart of projected growth of congested roadways around Puget Sound, 1995 - 2020*
 - Annual hours of delay per person will rise nearly 91% in urban centers, and 488% in rural areas
 - Daily durations of 'rush hour traffic congestion' will increase from ranges of 4 to 8 hours a day, to 5-1/2 to 12-1/2 hours of delay per day.
 - *Bar chart of projected increase in hours of delay, rural and urban, 1998-2020.*
 - Puget Sound ferries also predict 70% increase in demand for ferry service by 2020, despite ferry system already operating at near-peak capacity.
- **Changes in Autos Will Be Switch to Hybrid Engines, then Fuel Cells**
 - General Motors, Ford announced plans to market hybrids starting in 2005; GM hopes to sell 1 million hybrids by 2007.
 - New fuel economy requirements for model year 2005 light-duty trucks are 22.2 mpg, autos remain at 1990 levels of 27.5 mpg
 - Hybrid SUVs will get 40 mpg
 - Japanese and Europeans will launch fuel-cell powered cars within next five years, U.S. plans are for 2010.
 - Forecast is for 800,000 fuel cell cars to be sold in next decade.

- Ford's Model U concept car with hydrogen-powered engine has near zero emissions
 - 99% reduction in CO₂, 45 mpg and 300 mile range.
 - Car is nearly completely recyclable.

IV. Energy

- **Global Trend: energy consumption will increase 60% over next 20 years**
 - most of growth will be in developing countries, particularly Asia, Central and South America
 - Forecast shows increase in worldwide oil use of nearly 44 million barrels per day over current production capacity
 - Natural gas will remain fastest growing component of global energy consumption
 - projected to increase from 23% in 1998 to 28% in 2020
 - will account for 43% of total new energy used for electricity generation, from growing demand for new energy efficient gas turbine power plants
 - Nuclear power capacity will expand in developing countries, especially Asia, while decreasing in industrialized countries
- **Pacific Northwest's Dependency on Hydro Power Keeps It Vulnerable to Droughts**
 - Short-term forecast is no greater than 6 % by 2007, says Northwest Power Planning Council
 - Impact of low-flow years lessened by addition of 3,210 MW of new power plants, wind power, energy conservation since 2000-2001 crisis
 - Region is still dependent on hydro power and vulnerable to variability of the weather
- **Forecast shows additional 3,300 MW needed in Pacific Northwest in Next 25 Years (NWPPC forecast)**
 - Residential electricity consumption will grow 1.41% per year, slightly lower growth rate than in last ten years
 - Commercial electricity consumption will grow 2% per year, not including 10 aluminum smelters closed since 2001, although 8 of them may restart.
 - Relying on prices from wholesale market to encourage new power sources makes regional subject to prices 3-4 times higher in summer months.
 - Current prices are in range of \$20 MW hour, while new plants triggered when wholesale rates are \$30 - \$35 MW hour
 - Many studies (RAND, Tellus) recommend more investments in renewable energy resources and energy conservation to provide for future energy needs
 - Tellus report says energy conservation can cut demand 3,100 MW, and new wind, biomass , geothermal power can provide 9,000 MW
 - Costs would be competitive at 4.1 cents per kwh with 3.5 - 4 cents kwh for new gas-fired generation
- **PacifiCorp's new draft Integrated Resource Plan Projects Energy Needs for Next 20 Years**
 - Draft IRP shows need for additional 4,000 MW in capacity by 2014 for its customers in 6 states
 - Need for new energy sources due to 50% increase in load, and to replace expiring power contracts, reduced output from older dams.
 - Viewed natural gas prices as too volatile to rely as major fuel source, coal use is vulnerable to potential carbon taxes, environmental restrictions

- Identifies least-cost, risk-adjusted approach to be diverse portfolio, including 1,400 MW renewables and 450 MWa of demand-side management which are larger 1,200 MW for peaking capacity.

?? Chart of Northwest Regional Forecast's under-construction and planned, potential capacity for next 5 years

?? Pie charts on region's current energy supply and demand, and environmental impacts?

V. Agriculture

- **General trends for U.S. and Pacific Northwest 2002 - 2011 (USDA Forecast):**
 - Horticultural production increasing, with average annual growth rate of 3%
 - Exports projected to provide 22% of production value, although U.S. is net importer of horticultural products
 - Domestic demand for potatoes and potato-based products increasing 4-5% annually, but with more imports of frozen french fries from Canada expected
 - Greater domestic demand for fresh vegetables, with domestic production increasing 2.3% per year, and more imports
 - U.S. fruit and nut exports will increase 3% annually, and more imports
 - Processed fruit and vegetable exports will increase between 3% and 5% annually, with strongest growth potential in wine exports.
- **Oregon's highest value agricultural product is greenhouse and nursery products,**
 - 2001 value was \$696 million, a 14% increase over previous year
 - Hay also a high-value crop with increasing demand, higher prices
 - Both Idaho and Oregon had increased number of dairies, benefitting from greater value for milk production
 - 40% of Oregon's agricultural products are exports
 - Impacted by world prices, demand forces
 - Vulnerable to transportation problems
- **Agriculture Competes with Commercial, Housing Developers for Land**
 - ECONorthwest Study on farmland impacts from future growth scenarios show impacts on agriculture acreage, foregone revenue from sales of agriculture crops
 - Most common loss of farmland occurs on smaller tracts with highest population density, adjacent to urban environment
 - Lost acreage often includes high value farms but with less land intensive crops
 - e.g., grass seed, hay, orchards
 - Land in nursery crops, Christmas trees, woodlots and poplar plantations less likely to be converted, but loss would have greater economic impact on agriculture production.

VI. Ecosystem & Health Effects from Long Range Transport of Air Pollutants

- **National Park Service report on Air Quality in National Parks cites continuing damage from increase in ozone and nitrogen deposition**, despite regulations and measured reductions of emissions.
 - Unknown impacts of toxic airborne contaminants and climate change also of concern.
 - Current fire suppression policy will continue to increase risk of catastrophic fires, in wildland areas, as will potential long-term drought conditions from climate change.
 - Potential policy changes to allow greater access to parks by motorized vehicles will worsen local air and noise pollution problems in pristine areas.
- **The Arctic Council's Arctic Monitoring and Assessment Program reports that some polar bears and humans in the Arctic region are among the most exposed populations on the planet because of accumulating contaminants in their food.**
 - Toxics carried by wind and water currents ingested by fish and marine mammals then build up in those groups reliant on consumption of those animals.
 - Mercury levels in some Arctic natives found to be high enough to affect children's development.
- Georgia Basin - Puget Sound monitoring of harbour seals showed declining levels of PCBs and POPs stored in their fat
 - U.S. and Canada restricted use since 1970s, but recent trends showing leveling off of rate of decline points to atmospheric transport of toxics as remaining threat.
- NOAA-sponsored studies conducted over the past ten years for the International Global Atmospheric Chemistry Project (IGAC) indicate that
 - the source of oxidized sulfur, sulfur dioxide, and sulfate in aerosols found in the troposphere over the western Pacific were largely associated with emissions of sulfur dioxide from sources located in the Asian continent.
 - Ozone production over large areas of the Pacific basin can also be attributed to NO_x from Asia.
- Report by the Center for Biology of Natural Systems of Queens College, NY links toxic pollution appearing in Canadian Arctic to sources in U.S. and Mexico:
 - Nunavut, the region of Arctic Canada that was studied, shows high levels of dioxin that has been transported long distances by prevailing air currents.
 - Using mathematical and meteorological models, the study analyzes 1996-1997 data obtained by Canadian, Mexican and US environmental regulatory agencies.
 - About 70 to 82 percent, of dioxin in Nunavut is coming from US sources, which two-thirds comes from municipal waste incinerators, medical waste incinerators, cement kilns burning hazardous waste and backyard trash burning. Iron sintering, and copper and aluminum smelting are other major sources of dioxin, according to the report.
 - Canadian and Mexican sources accounted for the remaining dioxin emissions.

VII. Indoor Air

- **Increased exposure risk from trend for houses to be sealed more tightly to conserve energy, trapping pollutants inside the home.**
 - For many pollutants, levels inside are 2-5 times higher than outdoors, in both urban and rural areas
 - After some activities, indoor air pollutant levels can be as much as 1,000 times higher than outdoors.
 - In new non-residential buildings, levels of volatile organic compounds can be as much as 100 times higher than outdoors.
- **New EPA asthma research strategy sets general priorities for asthma research through 2009**
 - focus on addressing pollutants contributing to induction and exacerbation of asthma, including by products, particulate matter, molds and environmental tobacco smoke.
- **Mycotoxins and Indoor Molds being given serious consideration in indoor air quality investigations**
 - More tightly sealed houses, areas of new or increased flooding will increase incidence of toxic mold exposure.

VIII. Climate Change

- Potential Climate Change Impacts in the Pacific Northwest: UW's Climate Impacts Group
 - *Map of temperature trend for PNW*
 - *Diagram of impacts on freezing levels, snowmelt*
 - an **increase of 3 deg F** (including the 0.5 deg F that has already occurred over the past century) **by 2020 and 5 deg F by 2050**. Even 0.5 deg F has a big impact, as seen by El Nino years.
 - tendency towards wetter winters and drier summers, with extreme cases of winters with 22 % more precipitation, and summers with 26% less by 2050. Overall the models suggest **a 9% increase in winter precipitation and 5% decrease in the summer by 2050**. Under any scenario, more heat brings more evaporation, which will make for drier summer conditions.
- **Climate Solutions Cites More specific Impacts:**
 - Winters with substantially more rainfall, and summers with larger number of extremely hot days;
 - More frequent and destructive flooding and mudslides
 - A disrupted annual water cycle in which snowpack - on which the Columbia and other Northwest rivers depend during the summer - shrinks by half;
 - Droughts coming twice as frequently by 2020 and three times more often – three years out of every 10 – by 2050;
 - Salmon runs diminished or lost to an even greater degree than at present;
 - Water shortages which choke hydroelectric power production and irrigated farms
 - Ski seasons and runs shortened as snowline retreats to higher elevations;
 - Forest cover in Oregon and Washington sharply reduced, with forests retreating from the eastern slopes of the Cascades;
 - More numerous and intense forest fires and pest infestations, bringing major shifts in tree species distribution across the Northwest;
 - Human health impacts from worsened air pollution, increased heat waves and population of disease-carrying insect populations;
 - Rising seas which undermine coastal bluffs, cause landslides, drown highways and waterfronts, bring higher storm surges and cover tidal marshes vital to fish and birds.
- **Greatest potential danger from climate change in the PNW is the way warming might alter water flows.**
 - sometimes in winter and spring there will be too much water, causing floods and mudslides, and often there will be too little water in late summer and fall.
 - Forests will dry out, becoming more vulnerable to catastrophic fire and disease outbreaks.
 - Salmon will find new obstacles to spawning in swollen winter streams that wash out nests, as well as overheated summer streams with too little water.
 - Low flows will also choke hydro power production and irrigated farms.
 - The dry spells will be more intense due to increasing evaporation and changing runoff patterns.

- **Global warming threatens to eliminate half the Northwest snowpack resource, as less winter precipitation falls as snow and more as rain.**
The PNNL model shows:
 - average Cascade snowlines rising from its current 3,000 feet to 4,100 feet by 2050-80.
 - the volume of water stored in Northwest snowpack shrinking by 50% by 2050-80.
 - By 2050 runoff in Oregon and Washington will be higher but the peak will be sooner.
 - Earlier runoff will result from the shrinking snowpack and warmer, rainier spring months.
 - Streamflow will be reduced in July and August when it's most needed. .
- **Severe low flow events as experienced in 1987-88 and 1992-94 are now expected 4 years out of every 40;**
 - by 2020 under a middle of the road climate scenario, odds are for 8 drought years out of every 40 and by 2050, 12 out of every 40.
 - That represents a doubling of the risk in 20 years and a tripling of the risk in 50 years.
 - In heavier runoff years, the reservoirs fill to capacity – now they will be forced to spill water early. With low snowpack, there will also be less water to release in the extended summer period the region will experience from the higher temperature and greater evaporation.
 - One scenario developed by JISAO projects that the Columbia-Snake hydro systems, which now meets firm energy requirements 96% of the time, would slip down to 82% by 2050.
 - Even a 10% decrease in Northwest streamflows could result in the loss of generating capacity equivalent to what is needed to keep the lights on in Seattle.
- **For irrigation, reliability drops even more.**
 - For example, the Upper Snake now reliably provides water to farmers 97% of the time; by 2020 that is expected to drop to 84% of the time.
 - The Middle Snake, now reliable only 86% of the time, drops to 70%.
 - While the growing season may be longer, the higher temperature will increase the need for water while the water supply will be severely constricted.
- **More extreme weather events will alter the landscape and ecosystems**
 - Both Oregon and Washington could lose 15-25% of total forest cover, mostly conifers on the drying lower east slopes of the Cascades
 - More frequent drought will increase stress from forest fires, pests and disease
 - Greater storm surges and rising sea levels will erode coastline and beaches and increase chances of landslides.
 - Natural soil settling patterns in communities along inland straits will find themselves prone to flooding and storm surges.
 - The Puget Sound will be vulnerable to flooding from up to 9 inches of settling and rising sea levels as high as 20 inches by 2100
- **One climate model predicts the Arctic ice cap will vanish entirely during summers by 2050, other models say sometime after that.**
 - Already evidence that a “Northwest Passage” could be open for one or two months a

year five to ten years from now,

- The northwestern path through the ice would cut the travel distance between Europe and Asia by 6,800 miles, compared to Panama Canal route.

- **Recommended strategies:**

- Planning and adaptation to the negative impacts the region is likely to experience, such as water conservation and increased focus on slide and flooding hazards

- Lead by example to alter global trends, given the degree of vulnerability the Northwest has to climate affects beyond our control.

- CO2 emissions from energy-related activities could be reduced by increasing energy efficiency and using non-fossil sources of energy.

- Address transportation energy use, which is the both the largest greenhouse gas producer and fastest growing sector.

- Address potential land-use impacts on climate change by preserving open space and forests

- Preserve PNW's old growth forests as providers of massive carbon storage; after 40-60-year old range forests become strong sinks of CO2

- **Promote developing a regional business strategy that focuses on PNW's inherent strengths in addressing climate change:**

- Clean energy, including wind energy, solar power, and fuel cells, are reporting double-digit annual growth rates

- Opportunity to build a model hydrogen economy based on low-cost electricity generated by the Columbia River's massive dam system, electrolyzing water into its two components, hydrogen and oxygen, and distribute as fuel all around the region